C-REX-2 Addendum: ERPA-Bobs Adding multipoint electron temperature measurements to the CREX-2 mission

Completed Technology Project (2018 - 2020)

Project Introduction

This proposal is submitted in response to the HTIDS-2017 opportunity. The C-REX-2 sounding rocket was selected this past year (HTIDS-2016) to investigate neutral upwelling in the cusp using multiple point chemical releases. That proposal full title is "In-Situ Measurements of Neutral and Plasma Dynamics Associated with Earth's Cusp-Region Thermospheric Mass Density Anomaly", with PI Mark Conde of UAF/GI; it is called C-REX-2 for short. The C-REX-2 mission will support 20 rocket-ejected subpayloads releasing chemical tracers to be imaged from ground cameras, in order to visualize neutral winds in the cusp. A suite of flight instruments in the main payload will characterize the plasma environment and auroral precipitation. The overall goal is to obtain observational identification of the mechanisms that establish the anomalous enhancement of neutral density that is known to occur near the thermospheric footprint of Earth's geomagnetic cusp. In this addendum proposal, we propose to replace two of these chemical ejectable ("Ampules") with instrumented ejectables of the same mechanical envelope. These two ejectable ("Bobs"), derived from the recent Isinglass mission (PI K Lynch, Poker Flat, 2017) will be ejected at the same high velocities as the chemical ejectables. However, in place of the chemical payload, they will contain a thermal electron retarding potential analyzer ("eRPA", M Lessard, UNH). The two Bob ejectables will send information back to the main payload about the local thermal electron temperature, providing direct in situ information about the location of the cusp auroral activity at two points separated longitudinally from the main payload at distances comparable to the array of chemical releases. The C-REX-2 mission addresses fundamental science questions about the plasma physics environment surrounding neutral density profiles in the auroral cusp, and the proposed addendum allows us to exploit recent subpayload developments and successes to extend this study into two dimensions, both along the trajectory as planned, and across the trajectory plane longitudinally. The feasibility of the proposed addendum mission has been discussed and cleared with the Sounding Rocket Project Office (SRPO) (Phil Eberspeaker and John Hickman) of the Wallops Flight Facility. The additional effort described in this proposal can be streamlined into the existing mission plan with minimal disruption to the mission design. This ERPA-Bob addendum mission makes important technology development steps, in particular expanding on SRPO/NSROC developments for CubeSat-class autonomous sensorcraft regarding deployment of and telemetry networks for small subpayload arrays. Telemetered information on attitude and stability of the motor-deployed Ampule-type subpayloads will be a side benefit. Relevance to NASA's Heliophysics programs is clear in the 2014 NASA Science plan, which includes Heliophysics goals concerning "Advance our understanding of the connections that link the Sun, the Earth, and planetary space environments." As argued in the 2016-selected proposal, the C-REX-2 science question is important, significant, and timely.

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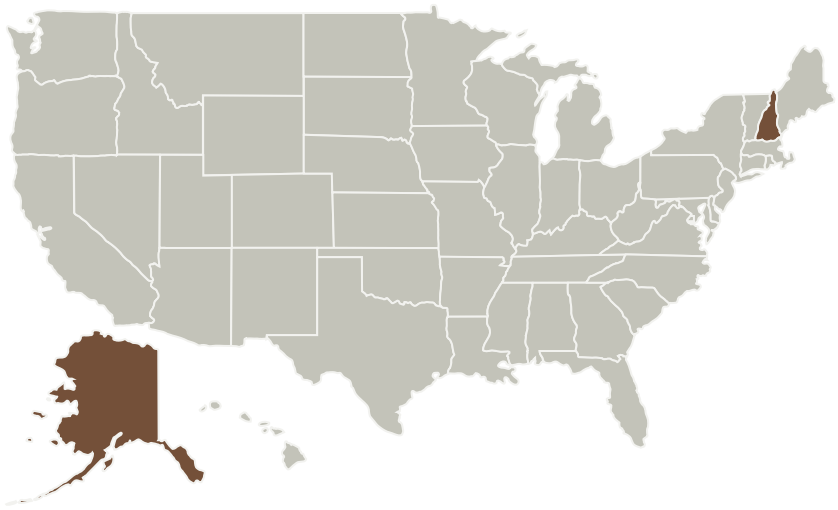
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Trustees of Dartmouth College	Lead Organization	Academia	Hanover, New Hampshire
Dartmouth College	Supporting Organization	Academia	Hanover, New Hampshire
Geophysical Institute	Supporting Organization	Industry	Fairbanks, Alaska
University of Alaska Fairbanks(UAF)	Supporting Organization	Academia Alaska Native and Native Hawaiian Serving Institutions (ANNH)	Fairbanks, Alaska
University of New Hampshire-Main Campus	Supporting Organization	Academia	Durham, New Hampshire

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Organization:

Trustees of Dartmouth College

Responsible Program:

Heliophysics Technology and Instrument Development for Science

Project Management

Program Director:

Roshanak Hakimzadeh

Program Manager:

Roshanak Hakimzadeh

Principal Investigator:

Kristina A Lynch

Co-Investigators:

Mark G Conde
Donald L Hampton
Marc R Lessard
Christine M Bothe

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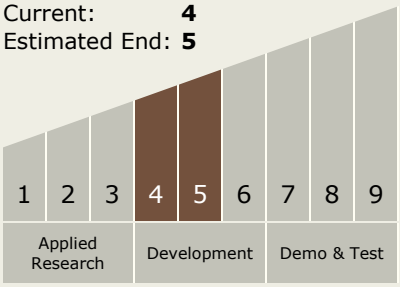
Primary U.S. Work Locations	
Alaska	New Hampshire

Technology Maturity (TRL)

Start: **4**
Current: **4**
Estimated End: **5**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destination

The Sun